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AF/1765

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Bailey III et al.

Application No.: 09/440,794

Filed: November 15, 1999

Title: MATERIALS FOR GAS CHEMISTRIES FOR PROCESSING SYSTEMS

Attorney Docket No.: LAM1P128/P0561

Examiner: Anderson, Matthew A.

Group: 1765

Confirmation No.: 3445

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first-class mail on January 8, 2004 in an envelope addressed to: Mail Stop Appeal Brief-Patent, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signed: Sue Funchess

Sue Funchess

TRANSMITTAL OF REPLY BRIEF IN RESPONSE TO EXAMINER'S ANSWER

Mail Stop Appeal Brief-Patents
Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith in triplicate is the Reply Brief In Response To Examiner's Answer mailed January 8, 2004.

This reply brief is being filed within two (2) months of the mailing date of the Examiner's Answer.

Applicant believes that no extension of term is required. If an additional extension of time is required, however, please consider this a petition therefor.

☒ Charge any additional fees or credit any overpayment to Deposit Account No. 50-0388, (Order No. LAM1P128).

Respectfully submitted,
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex Parte Andrew D. Bailey III, et al.

Application for Patent

Filed: November 15, 1999

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Group Art Unit: 1765

Examiner: Matthew A. Anderson

For: MATERIALS AND GAS CHEMISTRIES
FOR PROCESSING SYSTEMS

REPLY BRIEF

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1. INTRODUCTION

This Reply Brief is in response to the Examiner's Answer mailed November 19, 2003. Under 37 C.F.R. §1.193(b).

2. GROUPING OF THE CLAIMS

The Examiner is correct in point out that the applicant inadvertently left off the grouping of claims 49-56 in the appeal brief. Claims 49-56 were not placed in any group. The applicant corrects this with the following grouping of claims:

Claims 31-35 are grouped together and presented as the first group.

Similarly, claims 36-41 are presented as the second group.

Claims 42-45 and claims 49-56 are presented as the third group.

3. CLAIMS APPEALED

The Examiner's Answer is correct in stating that claim 31, was amended by an Examiner's amendment, which was not reflected in Appendix A of the Appeal Brief. A new listing of the claims is provided in the Appendix A of this Reply Brief to reflect the claims as amended by the Examiner.

4. ARGUMENT

A. Claim Rejections-35 USC § 112, first paragraph.

On page 8, of the Examiner's Answer, the Examiner stated that "The appellant has not specified where support for this negative limitation is found." On page 18, lines 1-4, of the Appeal Brief, the appellant stated that Fig. 2A and Fig. 2B and page 14, lines 21-23, provide support for the limitation "... wherein said different radial locations include at least one radial region which is not an axial direction perpendicular to said substrate."

The cited section states that field lines 140 in FIG. 2A are shown diverging from an annulus of high magnetic field strength with a radius near half the radius 144 of the chamber 146. As shown in both Fig. 2A and Fig. 2B, the magnetic field lines at a certain radius are substantially parallel to the substrate surface, not perpendicular.

Therefore at such a radial location, defined by the radius, is a radial region where the lines of force are not perpendicular to the substrate.

In addition, on the bottom of page 11 to page 12, of the Examiner's Answer, the Examiner states that the arguments of Point G in the Appeal Brief are persuasive. Point G of the Appeal Brief, provides the argument that the limitations are supported by the specification, and therefore claim 31 is not indefinite. The applicant presumes that on page 8 of the Examiner's Answer, the Examiner is merely restating previous arguments, but that on page 17 of the Examiner's Answer the Examiner is agreeing that claim 31 is not indefinite under 35 USC § 112, first paragraph.

B. Claim Rejections-35 USC § 103

In addition to the arguments, provided in the Appeal Brief, the applicant again points out that Lymberopoulos does not teach or suggest the feature of changing the radial variation in the controlled magnetic field within the plasma processing chamber in the region proximate to the antenna to control the density of the plasma when the reactant gasses are being flown in the plasma processing chamber, as recited in claim 31. Col. 10, lines 1-8, of Lymberopoulos, cited by the Examiner describes changing the magnetic field uniformity, but not changing the radial variation. The Examiner failed to point out how changing magnetic field uniformity suggests changing the radial variation of the magnetic field. Even if the Examiner is correct in the argument that the non-uniform magnetic field suggests a radial variation, the adjustment of the uniformity, does not suggest a radial variation. Hill does not suggest this feature. For at least these reasons and the reasons provided by the appeal brief, claim 31 is not made obvious by Lymberopoulos in view of Hills.

In the Examiner's Answer in the last paragraph of page 9, the Examiner states the Fig. 11 of Lymberpoulos has field lines that are similar to Fig. 2A of the application to show that the device shown in Fig. 11 of Lymberpoulos creates the same magnetic fields as claimed in claim 31. The magnetic field from the device of Fig. 11, is not the same as the magnetic field as recited in claim 31. It should be noted that part of the electromagnetic arrangement 150a and 150b in Lymberpoulos is not disposed above the plane defined by the substrate in claim 31. In addition, the magnetic arrangement 150a and 150b of Lymberpoulos is close to a solenoid configuration, which would provide a substantially uniform field at the surface of the

substrate that is substantially perpendicular to the substrate surface 130. Such magnetic field lines would be very different from the magnetic field lines provided by the magnetic arrangement 104 shown in Fig. 1 of the present application. The magnetic arrangement 104 shown in Fig. 1 is formed by coplanar coils, disposed above the substrate 122 and the antenna 102, and which forms the magnetic field lines shown in Fig. 2A and Fig. 2B. Therefore the configurations and magnetic fields are not similar, as argued by the Examiner, therefore similar results are not expected.

It should be noted that the correction to the grouping of the claims should be applied to the arguments of Point F on page 16 of the Appeal Brief. In the Appeal Brief, claims 42-45 and 49-56 are interchangeably discussed. The arguments for Point F are relevant to claims 42-45 and 49-56.

5. CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner's rejection of claims 31-45 and 49-56, as being obvious over the cited art is erroneous. Accordingly, the rejection of these claims should be reversed.

Respectfully submitted,
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10. APPENDIX A

CLAIMS ON APPEAL

31. (Previously presented) A method for controlling processing uniformity while processing a substrate using a plasma-enhanced process, comprising:

providing a plasma processing chamber having a single chamber, substantially azimuthally symmetric configuration within which a plasma is both ignited and sustained during said processing of said substrate, said plasma processing chamber having no separate plasma generation chamber;

providing a coupling window disposed at an upper end of said plasma processing chamber;

providing an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

providing an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field at different radial locations above said substrate within said plasma processing chamber in the region proximate to said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect density of said plasma in said region proximate to said coupling window and antenna;

providing a dc power supply coupled to said electromagnet arrangement;

placing said substrate into said plasma processing chamber;

flowing reactant gases into said plasma processing chamber, said reactant gases include a combination of gases, wherein two or more gases of said combination of gases included in said reactant gases is a $C_x F_y H_z O_w$ gas;

striking said plasma out of said reactant gases;

changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate to said antenna to control said density of said plasma when said reactant gases are being flown in said plasma processing and thereby improving processing uniformity across said substrate; and

wherein said different radial locations include at least one radial region which is not in an axial direction perpendicular to said substrate.

32. (Original) The method of claim 31 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2, SF_6, NF_3, NH_3, Cl_2 and HBr.

33. (Previously Presented) The method of claim 32 herein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

34. (Previously Presented) The method of claim 31 wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

35. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_5F_8, C_4F_8, C_4F_6, C_3F_6, C_2F_6 and CF_4.

36. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_2HF_8, C_2HF_5, CHF_3, $C_2H_2F_2$, $C_2H_2F_4$ and CH_2F_2.

37. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of:

C_5F_8 +CF_4+CHF_3+CH_2F_2;

C_4F_8 +CF_4+CHF_3+CH_2F_2;

C_4F_6 +CF_4+CHF_3+CH_2F_2;

C_3F_6 +CF_4+CHF_3+CH_2F_2;

C_2F_6 +CF_4+CHF_3+CH_2F_2;

C_2HF_5 +CF_4+CHF_3+CH_2F_2;

C_5F_8 +CF_4+CHF_3+$C_2H_2F_4$;

C_4F_8 +CF_4+CHF_3+$C_2H_2F_4$;

C_4F_6 +CF_4+CHF_3+$C_2H_2F_4$;

C_3F_6 +CF_4+CHF_3+$C_2H_2F_4$;

C_2F_6 +CF_4+CHF_3+$C_2H_2F_4$;

C_2HF_5 +CF_4+CHF_3+$C_2H_2F_4$;

C_5F_8 +CHF_3+C_2HF_5+CH_2F_2;

C_4F_8 +CHF_3+C_2HF_5+CH_2F_2;

C_4F_6 +CHF_3+C_2HF_5+CH_2F_2;

C_3F_6 +CHF_3+C_2HF_5+CH_2F_2;

C_2F_6 +CHF_3+C_2HF_5+CH_2F_2; and

CF_4 +CHF_3+C_2HF_5+CH_2F_2.

38. (Original) The method of claim 37 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 and SF_6.

39. (Original) The method of claim 38, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

40. (Original) The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 NF_3, NH_3, Cl_2 or HBr and SF_6.

41. (Original) The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

42. (Original) The method of claim 31 wherein said plasma processing chamber includes an inner surface and at least the inner surface of the plasma processing chamber is made of a material that does not substantially interact with reactive gas chemistries that are flown into said plasma processing chamber.

43. (Original) The plasma processing system of claim 42 wherein said material of said plasma processing chamber is selected from a group of materials consisting of

silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride

44. (Original) The method of claim 31, wherein said plasma processing chamber includes silicon carbide.

45. (Original) The method of claim 31 wherein said plasma processing chamber is made entirely of silicon carbide.

49. (Previously Presented) The method as recited in claim 31, wherein said plasma processing chamber includes an inner surface and at least said inner surface of the plasma processing chamber is made of a material that does not substantially interact with reactive gas chemistries that are flown into said plasma processing chamber.

50. (Previously Presented) The method as recited in claim 49, wherein said material of said plasma processing chamber is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride.

51. (Previously Presented) The method as recited in claim 49, wherein said material of said plasma processing chamber is silicon carbide.

52. (Previously Presented) The method as recited in claim 51, wherein the silicon carbide of said plasma processing chamber is selected from a group of materials consisting of Chemical Vapor Deposition (CVD), Slipcast Forming, hot-pressed and sintered, iso-statically-pressed and sintered formed silicon carbide.

53. (Previously Presented) The method as recited in claim 49, wherein material forming said inner surface of said plasma processing chamber is provided by a bonded assembly consisting of a suitable material bonded to the chamber wall.

54. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is bonded with an electrically conductive or a thermally conductive adhesive.

55. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is configured to reliably form a significant part of the plasma ground.

56. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is comprised of several segments or tiles of said suitable material bonded to the chamber wall.

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substrate that is substantially perpendicular to the substrate surface 130. Such magnetic field lines would be very different from the magnetic field lines provided by the magnetic arrangement 104 shown in Fig. 1 of the present application. The magnetic arrangement 104 shown in Fig. 1 is formed by coplanar coils, disposed above the substrate 122 and the antenna 102, and which forms the magnetic field lines shown in Fig. 2A and Fig. 2B. Therefore the configurations and magnetic fields are not similar, as argued by the Examiner, therefore similar results are not expected.

It should be noted that the correction to the grouping of the claims should be applied to the arguments of Point F on page 16 of the Appeal Brief. In the Appeal Brief, claims 42-45 and 49-56 are interchangeably discussed. The arguments for Point F are relevant to claims 42-45 and 49-56.

5. CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner's rejection of claims 31-45 and 49-56, as being obvious over the cited art is erroneous. Accordingly, the rejection of these claims should be reversed.

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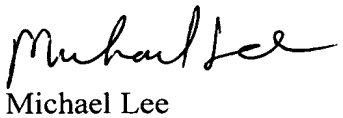

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providing a coupling window disposed at an upper end of said plasma processing chamber;

providing an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

providing an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field at different radial locations above said substrate within said plasma processing chamber in the region proximate to said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect density of said plasma in said region proximate to said coupling window and antenna;

providing a dc power supply coupled to said electromagnet arrangement;

placing said substrate into said plasma processing chamber;

flowing reactant gases into said plasma processing chamber, said reactant gases include a combination of gases, wherein two or more gases of said combination of gases included in said reactant gases is a $C_x F_y H_z O_w$ gas;

striking said plasma out of said reactant gases;

changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate to said antenna to control said density of said plasma when said reactant gases are being flown in said plasma processing and thereby improving processing uniformity across said substrate; and

wherein said different radial locations include at least one radial region which is not in an axial direction perpendicular to said substrate.

32. (Original) The method of claim 31 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2, SF_6, NF_3, NH_3, Cl_2 and HBr.

33. (Previously Presented) The method of claim 32 herein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

34. (Previously Presented) The method of claim 31 wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

35. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_5F_8, C_4F_8, C_4F_6, C_3F_6, C_2F_6 and CF_4.

36. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_2HF_8, C_2HF_5, CHF_3, $C_2H_2F_2$, $C_2H_2F_4$ and CH_2F_2.

37. (Previously Presented) The method of claim 31 wherein the reactant gases include a gas that is selected from a group of gases consisting of:

C_5F_8 +CF_4+CHF_3+CH_2F_2;

C_4F_8 +CF_4+CHF_3+CH_2F_2;

C_4F_6 +CF_4+CHF_3+CH_2F_2;

C_3F_6 +CF_4+CHF_3+CH_2F_2;

C_2F_6 +CF_4+CHF_3+CH_2F_2;

C_2HF_5 +CF_4+CHF_3+CH_2F_2;

C_5F_8 +CF_4+CHF_3+$C_2H_2F_4$;

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C_3F_6 +CHF_3+C_2HF_5+CH_2F_2;

C_2F_6 +CHF_3+C_2HF_5+CH_2F_2; and

CF_4 +CHF_3+C_2HF_5+CH_2F_2.

38. (Original) The method of claim 37 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 and SF_6.

39. (Original) The method of claim 38, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

40. (Original) The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 NF_3, NH_3, Cl_2 or HBr and SF_6.

41. (Original) The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

42. (Original) The method of claim 31 wherein said plasma processing chamber includes an inner surface and at least the inner surface of the plasma processing chamber is made of a material that does not substantially interact with reactive gas chemistries that are flown into said plasma processing chamber.

43. (Original) The plasma processing system of claim 42 wherein said material of said plasma processing chamber is selected from a group of materials consisting of

silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride

44. (Original) The method of claim 31, wherein said plasma processing chamber includes silicon carbide.

45. (Original) The method of claim 31 wherein said plasma processing chamber is made entirely of silicon carbide.

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52. (Previously Presented) The method as recited in claim 51, wherein the silicon carbide of said plasma processing chamber is selected from a group of materials consisting of Chemical Vapor Deposition (CVD), Slipcast Forming, hot-pressed and sintered, iso-statically-pressed and sintered formed silicon carbide.

53. (Previously Presented) The method as recited in claim 49, wherein material forming said inner surface of said plasma processing chamber is provided by a bonded assembly consisting of a suitable material bonded to the chamber wall.

54. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is bonded with an electrically conductive or a thermally conductive adhesive.

55. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is configured to reliably form a significant part of the plasma ground.

56. (Previously Presented) The method as recited in claim 53, wherein said bonded assembly is comprised of several segments or tiles of said suitable material bonded to the chamber wall.